Exhibit 5

Samsung – Smartphones and Tablets (models with IR cameras, models having cameras with IR sensitivity, and models with the Iris Scan feature. See Product List at end for models)

Infringement of the '413 patent

Claim 1	Evidence

1. A mobile communication device comprising a computational means and output means,	The Samsung smartphone is a mobile communication device that has a computational means and an output means.
	
	For example, the smartphone is a communication that includes a system-on-chip (SoC) device, which includes a main processor as a computational device, and a touchscreen, which is an output device.
	
	For example the Galaxy S4 includes a Qualcomm Snapdragon SoC CPU device and an AM-OLED touchscreen display:
	
	<table><tr><td>**Brand** ⓘ</td><td>Samsung</td></tr><tr><td>**Model** ⓘ</td><td>SM-T837T Galaxy Tab S4 10.5 2018 LTE-A US 64GB</td></tr><tr><td>**Brief** ⓘ</td><td>T-Mobile USA variant</td></tr><tr><td>**Released** ⓘ</td><td>2018 Sep 24</td></tr><tr><td>**Announced** ⓘ</td><td>2018 Aug 29</td></tr><tr><td>**Hardware Designer** ⓘ</td><td>Samsung Electronics</td></tr><tr><td>**Manufacturer** ⓘ</td><td>Samsung Electronics</td></tr></table> [6]
	
	⊞ Application processor, Chipset:
	CPU Clock ⓘ 2350 MHz
	CPU ⓘ Qualcomm Snapdragon 835 MSM8998, 2017, 64 bit, octa-core, 32 Kbyte I-Cache, 32 Kbyte D-Cache, 2048 Kbyte L2, 10 nm, Qualcomm Adreno 540 GPU ⟩⟩
	
	⊞ Operative Memory:
	RAM Type ⓘ mobile (LP) DDR4 SDRAM
	   1866 MHz ⓘ
	RAM Capacity ⓘ 4096 MiB RAM
	   3321 MiB user accessible RAM ⓘ
	[6]

1

❖ Display ⓘ

Display Diagonal ⓘ	266.2 mm
	10.5 inch ⓘ
Resolution ⓘ	1600x2560
	4096000 pixels ⓘ
Display Width ⓘ	141.09 mm
	5.55 inch ⓘ
Display Height ⓘ	225.74 mm
	8.89 inch ⓘ
Horizontal Full Bezel Width ⓘ	108.21 mm
Display Area ⓘ	31848.3 square millimeter
Display Area Utilization ⓘ	77.8%
Pixel Size ⓘ	0.08818 mm/pixel
Pixel Density ⓘ	288 PPI
Display Type ⓘ	Color AM-OLED ⓘ display
Display Subtype ⓘ	Super AM-OLED ⓘ
Display Color Depth ⓘ	24 bit/pixel
Number of Display Scales ⓘ	16.8M

[6]

For example, the Galaxy includes a Qualcomm Snapdragon SoC CPU device and an AM-OLED touchscreen:

Brand ⓘ	Samsung
Model ⓘ	SM-G990U1 Galaxy S21 FE 5G UW TD-LTE US 128GB
Brief ⓘ	Photography amateurs and pros-alike can effortlessly edit, post, and share scroll-stopping content. Unlocked single SIM variant of Galaxy S21 FE 5G UW for the US
Released ⓘ	2022 Jan 4
Announced ⓘ	2022 Jan 3
Hardware Designer ⓘ	Samsung Electronics
Manufacturer ⓘ	Samsung Electronics

[7]

2

⊞ Application processor, Chipset:

CPU Clock ⓘ	2842 MHz
CPU ⓘ	Qualcomm Snapdragon 888 5G SM8350 (Lahaina), 2021, 64 bit, octa-core, 5 nm, Qualcomm Adreno 660 GPU ⟫

⊞ Operative Memory:

RAM Type ⓘ	LPDDR5 SDRAM
	3200 MHz ⓘ
RAM Capacity ⓘ	6144 MiB RAM

[7]

◆ Display ⓘ

Display Hole ⓘ	1-hole
Display Diagonal ⓘ	162.9 mm
	6.4 inch ⓘ
Resolution ⓘ	1080x2340
	2527200 pixels ⓘ
Display Width ⓘ	68.26 mm
	2.69 inch ⓘ
Display Height ⓘ	147.91 mm
	5.82 inch ⓘ
Horizontal Full Bezel Width ⓘ	6.24 mm
Display Area ⓘ	10096.8 square millimeter
Display Area Utilization ⓘ	87.0%
Pixel Size ⓘ	0.06321 mm/pixel
Pixel Density ⓘ	402 PPI
Display Type ⓘ	Color AM-OLED ⓘ display
Display Subtype ⓘ	Dynamic AM-OLED ⓘ

[7]

For example, the Galaxy S9+ includes a Qualcomm Snapdragon SoC CPU device and an AM-OLED touchscreen:

3

Brand ⓘ	Samsung
Model ⓘ	SM-G965U1 Galaxy S9+ TD-LTE US
Released ⓘ	2018 Mar 16
Announced ⓘ	2018 Feb 25
Hardware Designer ⓘ	Samsung Electronics
Manufacturer ⓘ	Samsung Electronics

[8]

⊞ Application processor, Chipset:

CPU Clock ⓘ	2800 MHz
CPU ⓘ	Qualcomm Snapdragon 845 SDM845 (Napali), 2018, 64 bit, octa-core, 32 Kbyte I-Cache, 32 Kbyte D-Cache, 1536 Kbyte L2, 2048 Kbyte L3, 10 nm, Qualcomm Adreno 630 GPU ❯❯

⊞ Operative Memory:

RAM Type ⓘ	LPDDR4x SDRAM
	1866 MHz ⓘ
RAM Capacity (converted) ⓘ	6 GiB RAM

[8]

4

	❖ **Display** ⓘ
	Display Diagonal ⓘ 158.1 mm
	6.2 inch ⓘ
	Resolution ⓘ 1440x2960
	Horizontal Full Bezel 4.64 mm **Width** ⓘ
	Display Area Utilization ⓘ 84.3%
	Pixel Density ⓘ 529 PPI
	Display Type ⓘ AM-OLED ⓘ display
	Display Subtype ⓘ Super AM-OLED ⓘ
	Number of Display 16.8M **Scales** ⓘ
	Scratch Resistant Gorilla Glass 5 **Screen** ⓘ
	[8]
further comprising a module incorporating a non-contact temperature sensor for receiving from an external surface electromagnetic radiation in the infrared spectral range,	The Samsung smartphone further includes a module incorporating a non-contact temperature sensor for receiving from an external surface electromagnetic radiation in the infrared spectral range. For example, the Galaxy S4 and Note 3 models have an IR sensor, which is a smartphone module that is capable of sensing infrared electromagnetic radiation from an external source in a non-contact manner, thereby being operational as a non-contact temperature sensor.

5

	## Smartphones with thermometers do exist
	The idea is nothing new and manufacturers in their constant pursuit of innovation did give it a try. Namely, Samsung and Motorola had phones with thermometers once. Samsung did it with the Galaxy S4 and Note 3. According to the instructions for using this feature, measuring the temperature required you to leave the device to cool off from any heat it might have accumulated during use and leave it somewhere so it doesn't get warm from your hands. [1] For example, the Galaxy S21 Plus smartphone includes an IR camera, which is a smartphone module that is capable of sensing infrared electromagnetic radiation from an external source in a non-contact manner, thereby being operational as a non-contact temperature sensor.

6

Samsung Galaxy S21 Plus – Wide Camera Modified for Near Infrared Sensitivity

[2]

For example, the IR camera of the Galaxy S8, S8+, S9, S9+ and Note 8 models is used for the Iris Scan feature, whereby infrared radiation which inherently includes temperature information, reflected by a user's eyes is used to distinguish unique characteristics of the user's eyes.

7

Why do we use IR(Infrared Ray)?or Iris Scan in Samsung Galaxy S8+?

Last Update date : Oct 30. 2020

In the case of visible ray, Iris pattern can be easily interfered by the reflection from other stray visible light **UV light** is strong enough to sterilize so that it may ingenerate skin aging. For those reasons, iris scan technology uses safer IR.

[3]

8

With Iris Scanning, your Samsung Galaxy illuminates your eyes with an IR-LED and snaps an IR photograph. Then, your phone looks at the details of your eyes and compares them to previous pictures. If the phone can verify who you are, then it unlocks.

Hadrian/Shutterstock

[4]

<table>
<tr>
<td></td>
<td>

What is iris scanning and how to use it on Galaxy device

Last Update date : Jul 26. 2022

The iris recognition feature uses the unique characteristics of your irises, such as their shape and pattern, to strengthen the security of your device. Your iris data can be used for various authentication purposes.

Note: Device screenshots and menus may vary depending on the device model and software version.

Tips for using IRIS scanner ⌃

- Hold your device about 25-35 cm away from your face with the screen facing towards you. Position your eyes in the circles shown on the screen.

  Wearing glasses or contacts when unlocking your device or verifying your identity may cause the device to have difficulty recognizing your irises.
- Keep your eyes open and look at the top of the screen.
- IRIS recognition may not work properly in direct sunlight. For best results, perform this process indoors.
- Dirt and debris on the IRIS camera, LED sensor, or proximity sensor may cause the device to have difficulty recognizing your irises.

[5]
</td>
</tr>
<tr>
<td>such non-contact temperature sensor generates a signal.</td>
<td>

The non-contact temperature sensor of the Samsung smartphone generates a signal.

For example the IR sensor in the Galaxy S4 and Note 3 models worked as a non-contact temperature sensor to enable a user to take an ambient temperature reading. The IR sensor produces a signal that is used by the SoC processor to provide a numeric temperature reading to the user via the
</td>
</tr>
</table>

10

display.

Smartphones with thermometers do exist

The idea is nothing new and manufacturers in their constant pursuit of innovation did give it a try. Namely, Samsung and Motorola had phones with thermometers once. Samsung did it with the Galaxy S4 and Note 3. According to the instructions for using this feature, measuring the temperature required you to leave the device to cool off from any heat it might have accumulated during use and leave it somewhere so it doesn't get warm from your hands.

[1]

For example the IR camera in the Galaxy S21 Plus model generates an IR image signal that inherently includes temperature information, e.g. hotter objects appear brighter in the image, which enables a user to distinguish hot objects from colder objects, bare earth from vegetation etc.

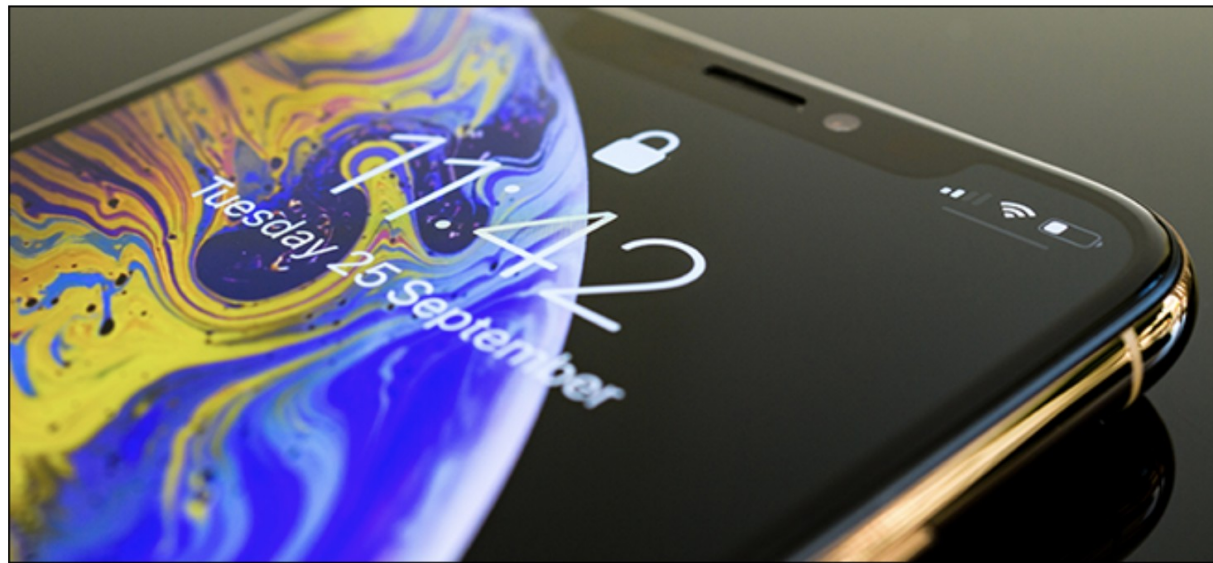**Samsung Galaxy S21 Plus – Wide Camera Modified for Near Infrared Sensitivity**

[2]

For example, the IR camera of the Galaxy S8, S8+, S9, S9+ and Note 8 models used for the Iris Scan feature generates an image signal responsive to the infrared radiation received from the user's iris and compares that image to previous images of the user's iris. If the images match sufficiently, the SoC unlocks the smartphone.

12

IR Scanning is Very Simple

Iris Scanner and Face ID are forms of biometric identification, and they're both used to unlock your phone and to open sensitive apps (banking apps, for example). Both processes are similar and easy to understand. New Apple and Samsung's phones are equipped with an IR-LED that emits near IR light, and an IR camera that is capable of capturing IR light.

With Iris Scanning, your Samsung Galaxy illuminates your eyes with an IR-LED and snaps an IR photograph. Then, your phone looks at the details of your eyes and compares them to previous pictures. If the phone can verify who you are, then it unlocks.
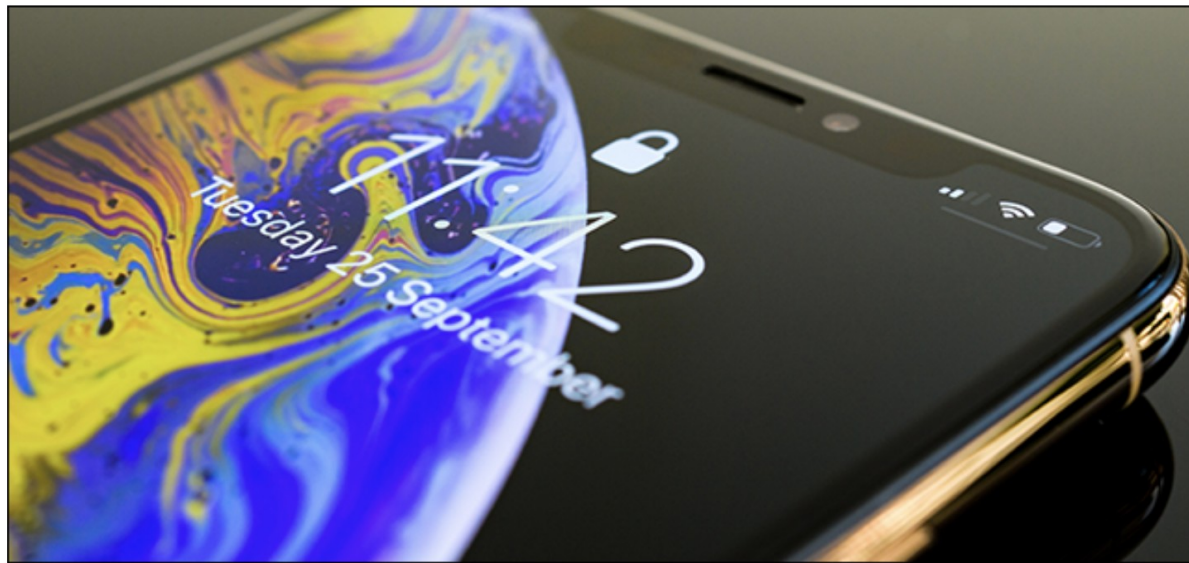
Hadrian/Shutterstock

[4]

13

Samsung – Smartphones and Tablets (models with the Iris Scan feature. See Product List at end for models)	
Infringement of the '413 patent	
Claim 6	Evidence
6. The mobile communication device of claim 1, wherein said external surface is part of a head of a human.	The Samsung smartphone is capable of receiving electromagnetic radiation from an external surface, wherein the external surface is part of a head of a human. For example, the Galaxy S8, S8+, S9, S9+ and Note 8 models have an Iris Scan feature that receives electromagnetic radiation from a human eye, which is part of a human head.

14

IR Scanning is Very Simple

Iris Scanner and Face ID are forms of biometric identification, and they're both used to unlock your phone and to open sensitive apps (banking apps, for example). Both processes are similar and easy t understand. New Apple and Samsung's phones are equipped with an IR-LED that emits near IR light, and an IR camera that is capable of capturing IR light.

With Iris Scanning, your Samsung Galaxy illuminates your eyes with an IR-LED and snaps an IR photograph. Then, your phone looks at the details of your eyes and compares them to previous pictures. If the phone can verify who you are, then it unlocks.

Hadrian/Shutterstock

[4]

15

Samsung – Smartphones and Tablets (models with IR cameras, models having cameras with IR sensitivity, and models with the Iris Scan feature. See Product List at end for models) Infringement of the '413 patent	
Claim 8	**Evidence**
8. A mobile communication device comprising a computational means and output means, further comprising:	The Samsung smartphone is a mobile communication device that has a computational means and an output means. For example, the smartphone is a communication that includes a system-on-chip (SoC) device, which includes a main processor as a computational device, and a touchscreen, which is an output device. For example the Galaxy S4 includes a Qualcomm Snapdragon SoC CPU device and an AM-OLED touchscreen display: 	Brand ⓘ	Samsung
Model ⓘ	SM-T837T Galaxy Tab S4 10.5 2018 LTE-A US 64GB
Brief ⓘ	T-Mobile USA variant
Released ⓘ	2018 Sep 24
Announced ⓘ	2018 Aug 29
Hardware Designer ⓘ	Samsung Electronics
Manufacturer ⓘ	Samsung Electronics	[6] ⚙ Application processor, Chipset: | CPU Clock ⓘ	2350 MHz
CPU ⓘ	Qualcomm Snapdragon 835 MSM8998, 2017, 64 bit, octa-core, 32 Kbyte I-Cache, 32 Kbyte D-Cache, 2048 Kbyte L2, 10 nm, Qualcomm Adreno 540 GPU ⟫ | 🗄 Operative Memory: | RAM Type ⓘ	mobile (LP) DDR4 SDRAM
	1866 MHz ⓘ
RAM Capacity ⓘ	4096 MiB RAM
	3321 MiB user accessible RAM ⓘ | [6]

16

❖ Display ⓘ

Display Diagonal ⓘ	266.2 mm
	10.5 inch ⓘ
Resolution ⓘ	1600x2560
	4096000 pixels ⓘ
Display Width ⓘ	141.09 mm
	5.55 inch ⓘ
Display Height ⓘ	225.74 mm
	8.89 inch ⓘ
Horizontal Full Bezel Width ⓘ	108.21 mm
Display Area ⓘ	31848.3 square millimeter
Display Area Utilization ⓘ	77.8%
Pixel Size ⓘ	0.08818 mm/pixel
Pixel Density ⓘ	288 PPI
Display Type ⓘ	Color AM-OLED ⓘ display
Display Subtype ⓘ	Super AM-OLED ⓘ
Display Color Depth ⓘ	24 bit/pixel
Number of Display Scales ⓘ	16.8M

[6]

For example, the Galaxy includes a Qualcomm Snapdragon SoC CPU device and an AM-OLED touchscreen:

Brand ⓘ	Samsung
Model ⓘ	SM-G990U1 Galaxy S21 FE 5G UW TD-LTE US 128GB
Brief ⓘ	Photography amateurs and pros-alike can effortlessly edit, post, and share scroll-stopping content. Unlocked single SIM variant of Galaxy S21 FE 5G UW for the
Released ⓘ	2022 Jan 4
Announced ⓘ	2022 Jan 3
Hardware Designer ⓘ	Samsung Electronics
Manufacturer ⓘ	Samsung Electronics

[7]

17

Application processor, Chipset:

CPU Clock ⓘ	2842 MHz
CPU ⓘ	Qualcomm Snapdragon 888 5G SM8350 (Lahaina), 2021, 64 bit, octa-core, 5 nm, Qualcomm Adreno 660 GPU

Operative Memory:

RAM Type ⓘ	LPDDR5 SDRAM
	3200 MHz ⓘ
RAM Capacity ⓘ	6144 MiB RAM

[7]

Display ⓘ

Display Hole ⓘ	1-hole
Display Diagonal ⓘ	162.9 mm
	6.4 inch ⓘ
Resolution ⓘ	1080x2340
	2527200 pixels ⓘ
Display Width ⓘ	68.26 mm
	2.69 inch ⓘ
Display Height ⓘ	147.91 mm
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Display Type ⓘ	Color AM-OLED ⓘ display
Display Subtype ⓘ	Dynamic AM-OLED ⓘ

[7]

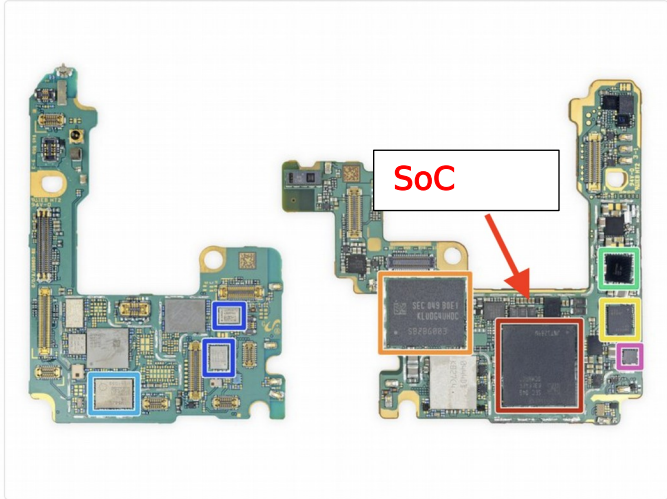For example, the Galaxy S9+ includes a Qualcomm Snapdragon SoC CPU device and an AM-OLED touchscreen:

18

Brand ⓘ	Samsung
Model ⓘ	SM-G965U1 Galaxy S9+ TD-LTE US
Released ⓘ	2018 Mar 16
Announced ⓘ	2018 Feb 25
Hardware Designer ⓘ	Samsung Electronics
Manufacturer ⓘ	Samsung Electronics

[8]

⚙ Application processor, Chipset:

CPU Clock ⓘ	2800 MHz
CPU ⓘ	Qualcomm Snapdragon 845 SDM845 (Napali), 2018, 64 bit, octa-core, 32 Kbyte I-Cache, 32 Kbyte D-Cache, 1536 Kbyte L2, 2048 Kby 10 nm, Qualcomm Adreno 630 GPU ⟫

⚏ Operative Memory:

RAM Type ⓘ	LPDDR4x SDRAM
	1866 MHz ⓘ
RAM Capacity (converted) ⓘ	6 GiB RAM

[8]

|	

	❖ **Display** ⓘ
	
	Display Diagonal ⓘ 158.1 mm
	                             6.2 inch ⓘ
	Resolution ⓘ 1440x2960
	Horizontal Full Bezel 4.64 mm
	Width ⓘ
	Display Area 84.3%
	Utilization ⓘ
	Pixel Density ⓘ 529 PPI
	Display Type ⓘ AM-OLED ⓘ display
	Display Subtype ⓘ Super AM-OLED ⓘ
	Number of Display 16.8M
	Scales ⓘ
	Scratch Resistant Gorilla Glass 5
	Screen ⓘ
	
	                                                   [8]

a module for receiving and measuring a magnitude of electromagnetic radiation, wherein said electromagnetic radiation is generated by a source that is not being part of the mobile communication device,	The Samsung smartphone further includes a module for receiving and measuring a magnitude of electromagnetic radiation, wherein the electromagnetic radiation is generated by a source that is not part of the mobile communication device. For example, the central module of the smartphone (e.g. Samsung Galaxy S21) is a module to which the Qualcomm Snapdragon SoC device and touchscreen are communicatively coupled during manufacturing of the smartphone. The main board of the smartphone includes an IR camera (or IR sensor), which is capable of sensing and measuring infrared electromagnetic radiation from a source that is not part of the smartphone.

Step 6

Camera

[9]

21

	Step 7 [9]
and such module comprising at least one antenna adapted for operation in the radio frequency range.	The Samsung the module of the smartphone includes at least one antenna adapted for operation in the radio frequency range. For example, the central module includes an RF antenna for cellular communications by the smartphone. The RF antenna is positioned at one corner of the central module.

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Step 12

Antenn
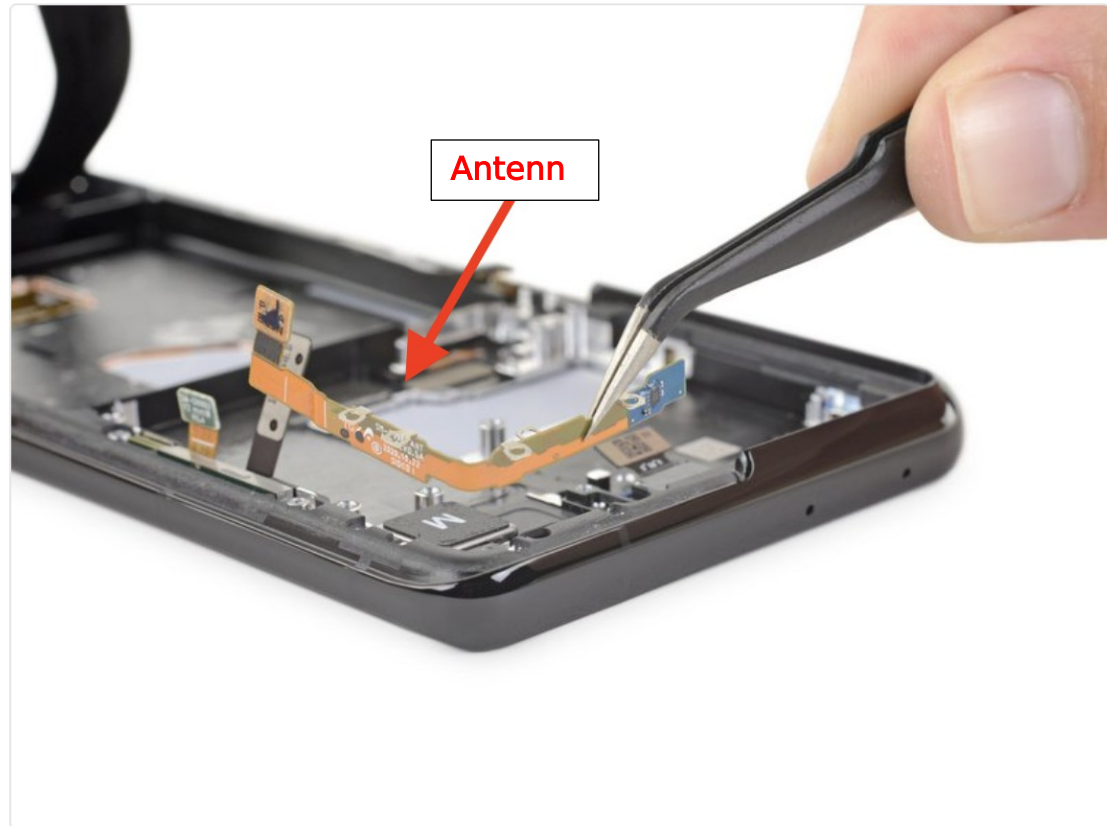
[9]

Samsung – Smartphones and Tablets (models with IR cameras, models having cameras with IR sensitivity, and models with the Iris Scan feature. See Product List at end for models) Infringement of the '413 patent	
Claim 9	**Evidence**
9. A method of measuring the magnitude of electromagnetic radiation in a selected location by a mobile communication device, consisting of the steps of:	The Samsung smartphone performs a method of measuring the magnitude of electromagnetic radiation in a selected location. For example, when the IR sensor is used for temperature sensing, or the IR camera is used to take an IR image (e.g. as in a scenic photo or for the Iris Scan feature) the smartphone measures the magnitude of infrared electromagnetic radiation received by the smartphone's IR camera (or IR sensor) from the location at which the IR camera/sensor is aimed. For example, the Galaxy S4 and Note 3 models have an IR sensor, which is a smartphone/tablet module that is capable of measuring the magnitude of infrared electromagnetic radiation from an external source. ## Smartphones with thermometers do exist The idea is nothing new and manufacturers in their constant pursuit of innovation did give it a try. Namely, Samsung and Motorola had phones with thermometers once. Samsung did it with the Galaxy S4 and Note 3. According to the instructions for using this feature, measuring the temperature required you to leave the device to cool off from any heat it might have accumulated during use and leave it somewhere so it doesn't get warm from your hands. [1] For example, the Galaxy S21 Plus smartphone includes an IR camera, which

24

is a smartphone module that is capable of measuring the magnitude of infrared electromagnetic radiation from a location at which the camera is aimed.

Samsung Galaxy S21 Plus – Wide Camera Modified for Near Infrared Sensitivity

[2]

For example, the IR camera of the Galaxy S8, S8+, S9, S9+ and Note 8 models is used for the Iris Scan feature, whereby the IR camera measures the magnitude of infrared radiation reflected by a user's eyes, a location at which the camera is aimed, to distinguish unique characteristics of the user's eyes.

25

Why do we use IR(Infrared Ray)?or Iris Scan in Samsung Galaxy S8+?

Last Update date : Oct 30. 2020

In the case of visible ray, Iris pattern can be easily interfered by the reflection from other stray visible light **UV light** is strong enough to sterilize so that it may ingenerate skin aging. For those reasons, iris scan technology uses safer IR.

[3]

26

	With Iris Scanning, your Samsung Galaxy illuminates your eyes with an IR-LED and snaps an IR photograph. Then, your phone looks at the details of your eyes and compares them to previous pictures. If the phone can verify who you are, then it unlocks.
	Hadrian/Shutterstock
	[4]
providing a mobile communication device that comprises a housing, a digital imaging sensor having a first field of view, such sensor is for generating a digital image of the selected location,	The Samsung smartphone further provides a mobile communication device that comprises a housing and a digital imaging sensor having a first field of view. The sensor is for generating a digital image of the selected location. For example, the smartphone includes a housing for enclosing a digital image sensor, among other components of the smartphone. The digital image sensor has a field of view (e.g. outwards from the rear of the smartphone) and is for generating a digital image of a subject or location at which it is aimed.

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For example the Galaxy S4 has 13.1 MP CMOS image sensor within a housing.

Samsung SM-T837T Galaxy Tab S4 10.5 2018 LTE-A US 64GB (Samsung T830) Detailed Tech Specs

Housing

[6]

⟳ **Primary Camera System** ⓘ

Camera Placement ⓘ	Rear
Camera Module ⓘ	Samsung S5K3L8
Camera Image Sensor ⓘ	CMOS ⓘ
Image Sensor Format ⓘ	1/3.06
Image Sensor Pixel Size ⓘ	1.12 micrometer
Camera Resolution ⓘ	4208x3120 pixel
Number of effective pixels ⓘ	13.1 MP camera

[6]

For example, the Galaxy S21 has 12MP BSI CMOS image sensor within a housing.

28

Samsung SM-G990U1 Galaxy S21 FE 5G UW TD-LTE US 128GB (Samsung G990) Detailed Tech Specs *Housing*

[7]

[7]

⚙ **Primary Camera System** ⓘ

Camera Placement ⓘ	Rear
Camera Module ⓘ	Samsung ISOCELL Plus S5K2LD
Camera Image Sensor ⓘ	BSI CMOS ⓘ
Image Sensor Format ⓘ	1/1.76
Image Sensor Pixel Size ⓘ	1.80 micrometer
Camera Resolution ⓘ	4000x3000 pixel
Number of effective pixels ⓘ	12.0 MP camera

[7]

[7]

For example, the Galaxy S9+ has a 12.2 MP BSI CMOS image sensor within a housing.

29

Samsung SM-G965U1 Galaxy S9+ TD-LTE
US (Samsung Star 2)   Housing

[8]

🔄 **Primary Camera System** ⓘ

Camera Placement ⓘ	Rear
Camera Image Sensor ⓘ	BSI CMOS ⓘ
Image Sensor Pixel Size ⓘ	1.40 micrometer
Number of effective pixels ⓘ	12.2 MP camera
Aperture (W) ⓘ	f/1.50
Aperture (T) ⓘ	f/2.40
Zoom ⓘ	1.0 x optical zoom
	8.0 x digital zoom ⓘ

[8]

a computational means,	The Samsung smartphone further provides a computational means.

For example, the SoC CPU device includes a main processor for performing computational processing.

For example the Galaxy S4 includes a Qualcomm Snapdragon SoC CPU device:

Brand ⓘ	Samsung
Model ⓘ	SM-T837T Galaxy Tab S4 10.5 2018 LTE-A US 64GB
Brief ⓘ	T-Mobile USA variant
Released ⓘ	2018 Sep 24
Announced ⓘ	2018 Aug 29
Hardware Designer ⓘ	Samsung Electronics
Manufacturer ⓘ	Samsung Electronics

[6]

⊞ Application processor, Chipset:

CPU Clock ⓘ	2350 MHz
CPU ⓘ	Qualcomm Snapdragon 835 MSM8998, 2017, 64 bit, octa-core, 32 Kbyte I-Cache, 32 Kbyte D-Cache, 2048 Kbyte L2, 10 nm, Qualcomm Adreno 540 GPU ⏩

⊞ Operative Memory:

RAM Type ⓘ	mobile (LP) DDR4 SDRAM
	1866 MHz ⓘ
RAM Capacity ⓘ	4096 MiB RAM
	3321 MiB user accessible RAM ⓘ

[6]

For example, the Galaxy includes a Qualcomm Snapdragon SoC CPU device:

Brand ⓘ	Samsung
Model ⓘ	SM-G990U1 Galaxy S21 FE 5G UW TD-LTE US 128GB
Brief ⓘ	Photography amateurs and pros-alike can effortlessly edit, post, and share scroll-stopping content. Unlocked single SIM variant of Galaxy S21 FE 5G UW for the US
Released ⓘ	2022 Jan 4
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[7]

Application processor, Chipset:

CPU Clock ⓘ	2842 MHz
CPU ⓘ	Qualcomm Snapdragon 888 5G SM8350 (Lahaina), 2021, 64 bit, octa-core, 5 nm, Qualcomm Adreno 660 GPU ≫

Operative Memory:

RAM Type ⓘ	LPDDR5 SDRAM
	3200 MHz ⓘ
RAM Capacity ⓘ	6144 MiB RAM

[7]

For example, the Galaxy S9+ includes a Qualcomm Snapdragon SoC CPU device:

Brand ⓘ	Samsung
Model ⓘ	SM-G965U1 Galaxy S9+ TD-LTE US
Released ⓘ	2018 Mar 16
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Hardware Designer ⓘ	Samsung Electronics
Manufacturer ⓘ	Samsung Electronics

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Operative Memory:

RAM Type ⓘ	LPDDR4x SDRAM
	1866 MHz ⓘ
RAM Capacity (converted) ⓘ	6 GiB RAM

[8]

and an output means for	The Samsung smartphone further provides an output means for conveying

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conveying information to an operator;	information to an operator. For example, the smartphone also includes a touchscreen display for conveying information to an operator. For example the Galaxy S4 includes an AM-OLED touchscreen display:

Brand ⓘ	Samsung
Model ⓘ	SM-T837T Galaxy Tab S4 10.5 2018 LTE-A US 64GB
Brief ⓘ	T-Mobile USA variant
Released ⓘ	2018 Sep 24
Announced ⓘ	2018 Aug 29
Hardware Designer ⓘ	Samsung Electronics
Manufacturer ⓘ	Samsung Electronics

[6]

33

❖ Display ⓘ

Display Diagonal ⓘ	266.2 mm
	10.5 inch ⓘ
Resolution ⓘ	1600x2560
	4096000 pixels ⓘ
Display Width ⓘ	141.09 mm
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Display Height ⓘ	225.74 mm
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Display Subtype ⓘ	Super AM-OLED ⓘ
Display Color Depth ⓘ	24 bit/pixel
Number of Display Scales ⓘ	16.8M

[6]

For example, the Galaxy S21 includes an AM-OLED touchscreen display:

Brand ⓘ	Samsung
Model ⓘ	SM-G990U1 Galaxy S21 FE 5G UW TD-LTE US 128GB
Brief ⓘ	Photography amateurs and pros-alike can effortlessly edit, post, and share scroll-stopping content. Unlocked single SIM variant of Galaxy S21 FE 5G UW for the US
Released ⓘ	2022 Jan 4
Announced ⓘ	2022 Jan 3
Hardware Designer ⓘ	Samsung Electronics
Manufacturer ⓘ	Samsung Electronics

[7]

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Display

Display Hole	1-hole
Display Diagonal	162.9 mm
	6.4 inch
Resolution	1080x2340
	2527200 pixels
Display Width	68.26 mm
	2.69 inch
Display Height	147.91 mm
	5.82 inch
Horizontal Full Bezel Width	6.24 mm
Display Area	10096.8 square millimeter
Display Area Utilization	87.0%
Pixel Size	0.06321 mm/pixel
Pixel Density	402 PPI
Display Type	Color AM-OLED display
Display Subtype	Dynamic AM-OLED

[7]

For example, the Galaxy S9+ includes an AM-OLED touchscreen:

Brand	Samsung
Model	SM-G965U1 Galaxy S9+ TD-LTE US
Released	2018 Mar 16
Announced	2018 Feb 25
Hardware Designer	Samsung Electronics
Manufacturer	Samsung Electronics

[8]

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❖ **Display** ⓘ

Display Diagonal ⓘ	158.1 mm
	6.2 inch ⓘ
Resolution ⓘ	1440x2960
Horizontal Full Bezel Width ⓘ	4.64 mm
Display Area Utilization ⓘ	84.3%
Pixel Density ⓘ	529 PPI
Display Type ⓘ	AM-OLED ⓘ display
Display Subtype ⓘ	Super AM-OLED ⓘ
Number of Display Scales ⓘ	16.8M
Scratch Resistant Screen ⓘ	Gorilla Glass 5

[8]

incorporating into the housing a module that is responsive to intensity of the electromagnetic radiation in a selected spectral range;	The Samsung smartphone incorporates into the housing a module that is responsive to intensity of the electromagnetic radiation in a selected spectral range. For example, the IR camera/sensor of the smartphone is responsive to electromagnetic radiation in the infrared range and is enclosed in the smartphone's housing. For example, the Galaxy S4 and Note 3 models have an IR sensor, which is a smartphone/tablet module that is capable of measuring the magnitude of electromagnetic radiation in the infrared range.

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Smartphones with thermometers do exist

The idea is nothing new and manufacturers in their constant pursuit of innovation did give it a try. Namely, Samsung and Motorola had phones with thermometers once. Samsung did it with the Galaxy S4 and Note 3. According to the instructions for using this feature, measuring the temperature required you to leave the device to cool off from any heat it might have accumulated during use and leave it somewhere so it doesn't get warm from your hands.

[1]

For example, the Galaxy S21 Plus smartphone includes an IR wide angle camera, which is a smartphone module that is capable of measuring the magnitude of electromagnetic radiation in the infrared range.

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**Samsung Galaxy S21 Plus – Wide Camera Modified for Near Infrared Sensitivity**
[2]

For example, the IR camera of the Galaxy S8, S8+, S9, S9+ and Note 8 models is used for the Iris Scan feature, whereby the IR camera measures the magnitude of electromagnetic radiation in the infrared range that is reflected by a user's eyes to distinguish unique characteristics of the user's eyes.

Why do we use IR(Infrared Ray)?or Iris Scan in Samsung Galaxy S8+?

Last Update date : Oct 30. 2020

In the case of visible ray, Iris pattern can be easily interfered by the reflection from other stray visible light **UV light** is strong enough to sterilize so that it may ingenerate skin aging. For those reasons, iris scan technology uses safer IR.

[3]

39
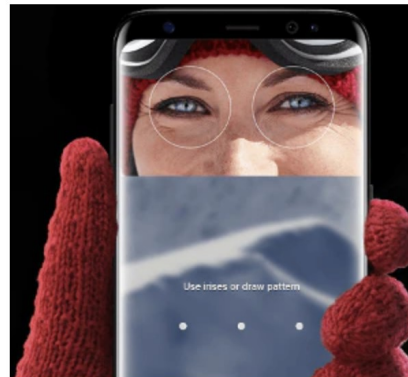
	With Iris Scanning, your Samsung Galaxy illuminates your eyes with an IR-LED and snaps an IR photograph. Then, your phone looks at the details of your eyes and compares them to previous pictures. If the phone can verify who you are, then it unlocks. 📷 Hadrian/Shutterstock [4]
positioning the housing in a vicinity of the selected location;	As directed by marketing and operational instructions, a user of the Samsung smartphone positioning the housing in a vicinity of the selected location when using the Iris Scan feature or the IR camera. For example, an end user or Samsung test engineer, positions the smartphone such that it is in the vicinity of an external surface emitting infrared radiation in order to take a temperature reading, or in the vicinity of a subject and pointed thereat to take an IR wide angle image of the subject, or in the vicinity of a user and pointed at the user's eyes to use the Iris Scan feature, as the case may be for a given smartphone model.

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For example, the Galaxy S4 and Note 3 models have an IR sensor. To take a temperature reading, the S4 or Note 3 tablet needs to be placed in the vicinity of infrared electromagnetic radiation from an external source.

Smartphones with thermometers do exist

The idea is nothing new and manufacturers in their constant pursuit of innovation did give it a try. Namely, Samsung and Motorola had phones with thermometers once. Samsung did it with the Galaxy S4 and Note 3. According to the instructions for using this feature, measuring the temperature required you to leave the device to cool off from any heat it might have accumulated during use and leave it somewhere so it doesn't get warm from your hands.

[1]

For example, the Galaxy S21 Plus smartphone includes an IR camera. In order to take an IR photo of a subject, the smartphone needs to be positioned so that the IR camera is in the vicinity of the subject and pointed at the subject.

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Samsung Galaxy S21 Plus – Wide Camera Modified for Near Infrared Sensitivity
[2]

For example, the IR camera of the Galaxy S8, S8+, S9, S9+ and Note 8 models is used for the Iris Scan feature. In order to use the Iris Scan feature, the smartphone needs to be positioned in the vicinity of the user's face with the IR camera pointed at the user's eyes.

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Why do we use IR(Infrared Ray)?or Iris Scan in Samsung Galaxy S8+?

Last Update date : Oct 30. 2020

In the case of visible ray, Iris pattern can be easily interfered by the reflection from other stray visible light **UV light** is strong enough to sterilize so that it may ingenerate skin aging. For those reasons, iris scan technology uses safer IR.

[3]

43

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With Iris Scanning, your Samsung Galaxy illuminates your eyes with an IR-LED and snaps an IR photograph. Then, your phone looks at the details of your eyes and compares them to previous pictures. If the phone can verify who you are, then it unlocks.

📷 Hadrian/Shutterstock

[4]

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generating by the module a signal representative of the electromagnetic radiation;

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The module of the Samsung smartphone generates a signal representative of the electromagnetic radiation.

For example, the IR camera/sensor generates a signal responsive to the infrared electromagnetic radiation received from the location or subject at which the IR camera is pointed, or from the vicinity in which the smartphone is placed.

For example the IR sensor in the Galaxy S4 and Note 3 models produces a signal that is used by the SoC processor to provide a numeric temperature

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</table>

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| | reading to the user via the display. The temperature reading is representative of the infrared electromagnetic radiation received by the IR sensor.

Smartphones with thermometers do exist

The idea is nothing new and manufacturers in their constant pursuit of innovation did give it a try. Namely, Samsung and Motorola had phones with thermometers once. Samsung did it with the Galaxy S4 and Note 3. According to the instructions for using this feature, measuring the temperature required you to leave the device to cool off from any heat it might have accumulated during use and leave it somewhere so it doesn't get warm from your hands.

[1]
For example the IR camera in the Galaxy S21 Plus model generates an IR image signal that is representative of the infrared electromagnetic radiation, e.g. hotter objects appear brighter in the image, which enables a user to distinguish hot objects from colder objects, bare earth from vegetation etc. |

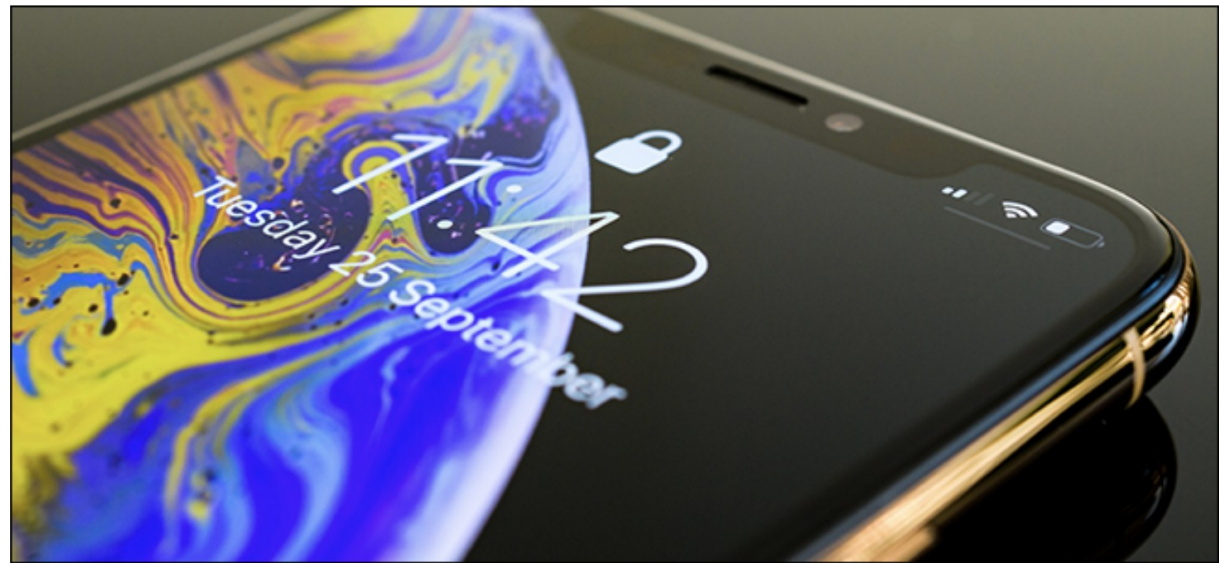**Samsung Galaxy S21 Plus – Wide Camera Modified for Near Infrared Sensitivity**
[2]

For example, the IR camera of the Galaxy S8, S8+, S9, S9+ and Note 8 models used for the Iris Scan feature generates an image signal responsive to the infrared electromagnetic radiation received from the user's iris.

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	## IR Scanning is Very Simple Iris Scanner and Face ID are forms of biometric identification, and they're both used to unlock your phone and to open sensitive apps (banking apps, for example). Both processes are similar and easy to understand. New Apple and Samsung's phones are equipped with an IR-LED that emits near IR light, and an IR camera that is capable of capturing IR light. With Iris Scanning, your Samsung Galaxy illuminates your eyes with an IR-LED and snaps an IR photograph. Then, your phone looks at the details of your eyes and compares them to previous pictures. If the phone can verify who you are, then it unlocks. 📷 Hadrian/Shutterstock [4]
processing said signal to extract information	The Samsung smartphone processes the signal to extract information related to intensity of the electromagnetic radiation in the selected location.

| related to intensity of the electromagnetic radiation in the selected location, and | For example, the main processor in the SoC device processes the signal to extract information of the infrared electromagnetic radiation, in the location of the IR sensor or at which the IR camera is pointed in the case of the IR wide angle camera and Iris Scan feature.

For example the IR sensor in the Galaxy S4 and Note 3 models produces a signal that is used by the SoC processor to provide a numeric temperature reading to the user via the display.[1]

For example the IR camera in the Galaxy S21 Plus model generates an IR image signal that is representative of the infrared electromagnetic radiation and provides the image to the user on the display of the smartphone. [2]

For example, the IR camera of the Galaxy S8, S8+, S9, S9+ and Note 8 models used for the Iris Scan feature generates an image signal responsive to the infrared radiation received from the user's iris. The SoC device processes the signal to extract information, based in part on the intensity of the received infrared electromagnetic radiation, to determine characteristics of the user's iris. If the characteristics sufficiently match previously recorded characteristics, the SoC unlocks the smartphone. [3] [4] [5] |
| sending said information to the output means for conveying the information to the operator. | The Samsung smartphone sends the information to the output means for conveying the information to the operator.

For example, depending on the feature being activated, the SoC processor sends the information to the touchscreen display, which causes the display to be unlocked as in the case of the Iris Scan feature, or to display a temperature, or to display an IR image captured with the IR camera. [1] [2] [3] [4] [5] |

Product List:

Smartphones with IR cameras: Galaxy S4 and Note3 smartphones

Smartphones with wide camera having near IR sensitivity: Galaxy S21 Plus smartphone

Smartphones with the Iris Scan feature: Galaxy S8, S8+, S9, S9+ and Note 8 smartphones/tablets

<u>**References:**</u>

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video at 0:08

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[4] Galaxy S8, S8+, S9, S9+ and Note 8 smartphones
https://www.howtogeek.com/404731/are-ir-scanners-in-phones-bad-for-your-eyes/

[5] Galaxy S8, S8+, S9, S9+ and Note 8 smartphones
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